

CN406 Fundamentals of GNSS II with emphasis on GPS
September 20, 2010, 1:30 pm-5:00 pm, CEU: 3.0
GNSS Solutions® Tutorials prior to ION GNSS 2010, September 20-21, 2010
Oregon Convention Center, Portland, Oregon, USA

Instructor: Dr. Chris G. Bartone, P.E., Professor, Ohio University

Prerequisite: Knowledge of mathematics, computer science, or engineering, and an introduction to satellite navigation systems (e.g., CN405 Fundamentals of GNSS I with emphasis on GPS) will be useful.

Intended Audience: Engineers, scientists, and managers interested in the area of GNSS using GPS, Galileo, Glonass and/or satellite navigation system. The course provides a solid basis in the understanding of error sources and their mitigation in GNSS systems. The course is more advanced than a simple user's or into to GNSS course, but not too detailed for the beginner to GNSS.

Notes Provided: Slides presented will be professionally spiral bound, with clear plastic cover, including color to add clarity where needed.

Reference List: A reference list will be provided as part of the note package for completeness and to allow the interested attendee to obtain additional information.

Course Overview: This course emphasizes the fundamentals of GNSS with emphasis on GPS in the presents of various error sources and presents various error mitigation techniques. The course provided details on the source and nature of various error source in satellite navigation systems, their impact, and methods for mitigation. Differential GNSS will be presented to include correction-based, measurement based, single, double, and triple differencing techniques for various baseline lengths. The course includes illustration of an error mitigated user state calculation with real GPS data.

Course Content: The main topics to be covered by this course are:

- GPS error budget (review)
- Overview of GNSS receiver and antenna technologies and tracking loops
- Atmosphere Errors:
 - Troposphere error sources and characterization, models and mitigation (simple)
 - Ionosphere error sources and characterization, models and mitigation
 - GPS Broadcast model (i.e, Klobuchar Model)
 - Dual-frequency mitigation
- Satellite orbit and clock errors, and mitigation methods
- Signal Multipath Error characterization and mitigation techniques
- Smoothing
 - Single-frequency methods
 - Dual-frequency methods
- Code-minus-Carrier and Code-Carrier-Divergence Analysis
- GNSS Receiver Autonomous Integrity Monitoring (RAIM)-overview

- Precise Point Positioning
 - Concepts, implementation, and limitations
- Differential GNSS (DGNSS) and different ways to implement it.
 - Correction-based methods
 - Example systems: NDGPS, WAAS, LAAS.
 - Measurement-based methods
 - Single-differencing
 - Double-differencing
 - Triple-differencing

Course Outcomes: At the completion of this course, the attendee should have the ability to understand the fundamentals of GNSS in the presents of measurement error, be able to implement various error mitigation techniques including PPP and DGNSS. Knowledge gained in the understanding and implementation of various error mitigation techniques will enable an error mitigated user's solution. For further knowledge on Modernized GPS or Future GNSS Signal Processing, CN420 Modernized GPS and Relation to other GNSS, and CN433 & CN434 Receiver Signal Processing for Future GNSS Signals are recommended.